NAVY AIR & SURFACE WEAPONS TECHNOLOGY PROGRAM (ASWT)

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NAVAL SURFACE WARFARE CENTER, DAHLGREN DIVISION

NAVAL SURFACE WARFARE CENTER, INDIAN HEAD DIVISION

Navy Air & Surface Weapons Technology Program (ASWT)

VISION:

Maintain Naval Air and Surface Weapons Capability Edge Through 21st Century

- Affordable, Precise

- Mission Adaptable, Mission Responsive

- Insensitive, Safe

- Higher Performance

- Higher Effectiveness

Navy Air & Surface Weapons Technology Program (ASWT)

Major ASWT Program Tennants/Technical POCs BY MISSION AREA	Example Systems or Programs Supported
• Air Superiority (Air to Air Warfare, AAW)	AIM-9X, AIM-120
POC: Mr. Stacey Howard (760) 939-3764	
• Naval Surface Fire Support (NSFS)	VGAS, EX-171
POC: Mr. Roger Horman (540) 653-8737	LASM, NTACMS
• Ship Self Defense (SSD)	CIWS, Standard Missile
POC: Mr. Gil Graff (540) 653-4099	RAM, ESSM
• Precision Strike	
POC: Mr. Tom Loftus (760) 939-3544	Tomahawk, SLAM-ER

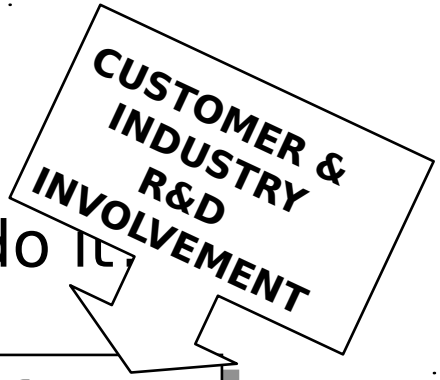
Questions Navy ASWT Program Needs to Answer...

What are we trying to do?

By When?

What difference will it make?

What makes you think you can do it?

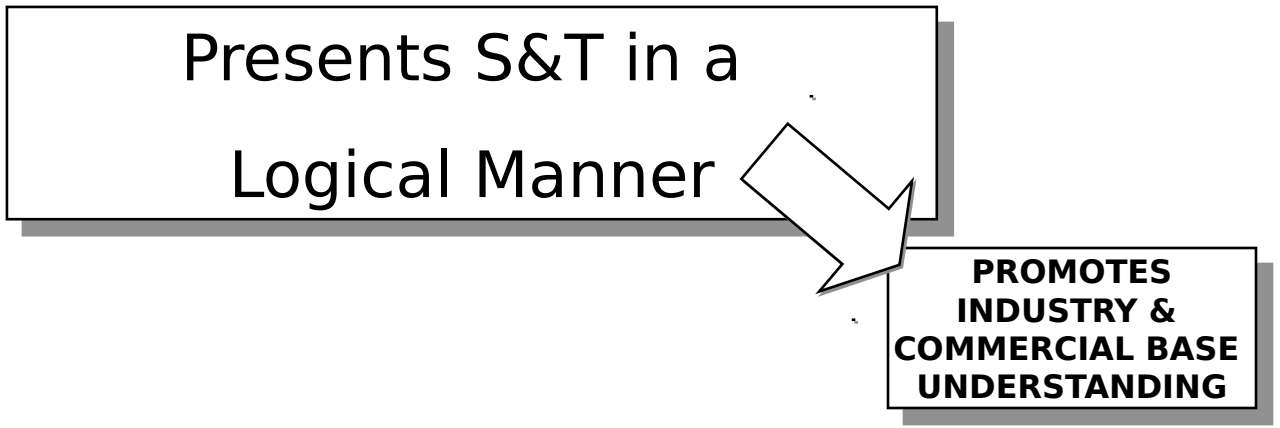


Need to Know the Future of Technology,

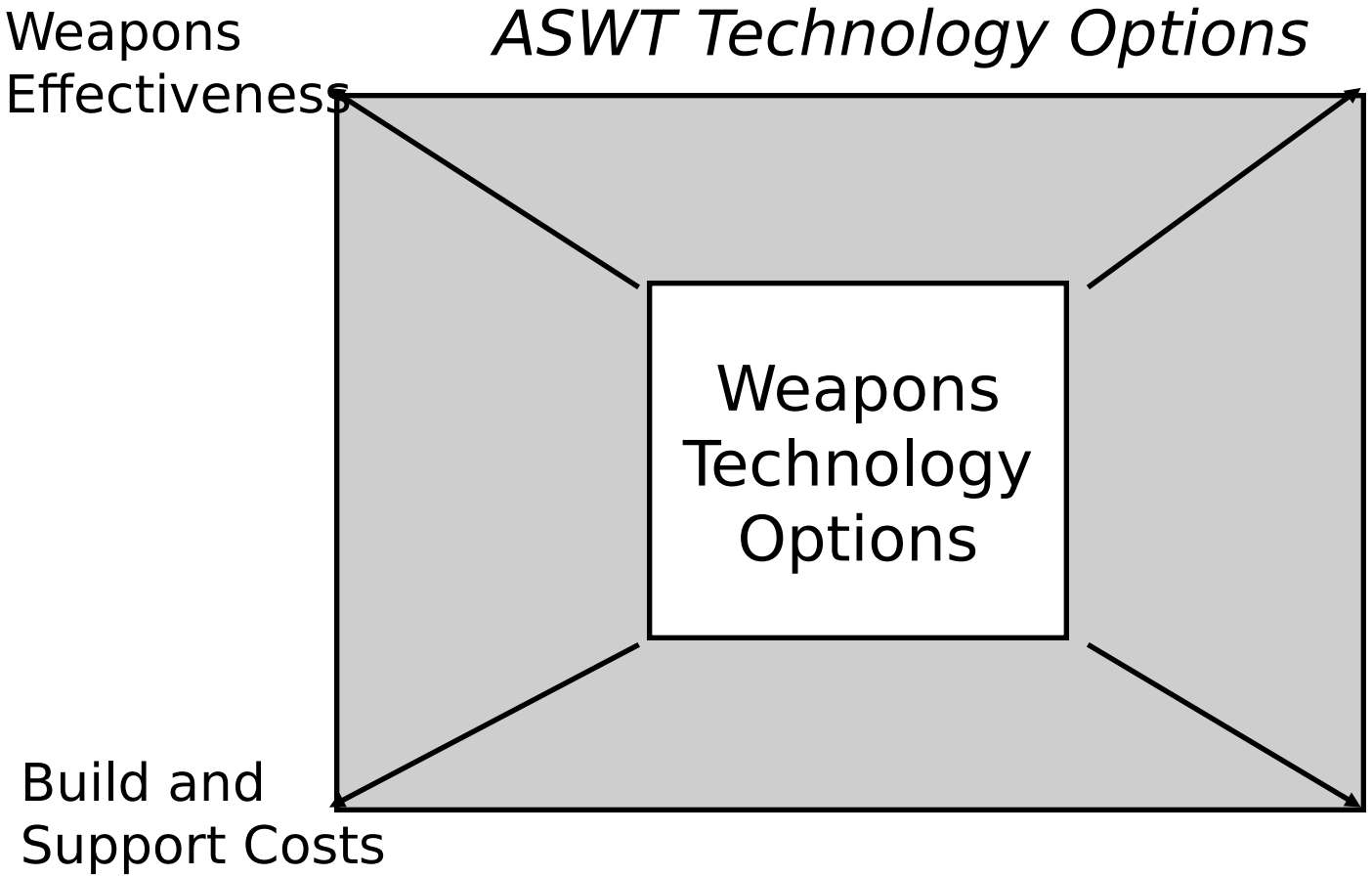
Not be Surprised by it.

Program Technology
“Traceability”

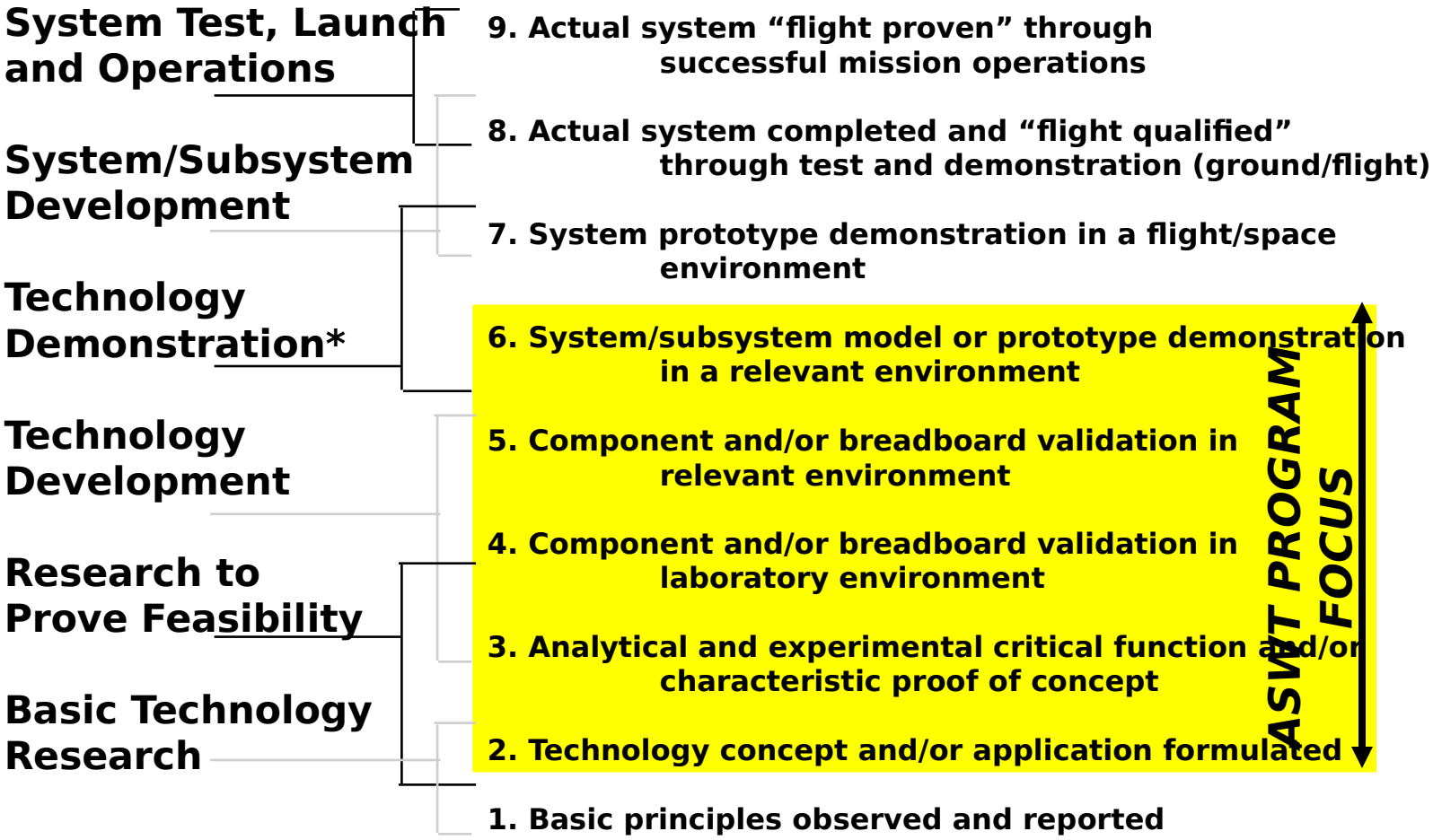
- System Payoff / Warfighter Benefit
- Quantitative Goals
- Objectives to meeting the goals
- Technical challenges
- Approach



ASWT Program Technology Expands the Weapons Design Box

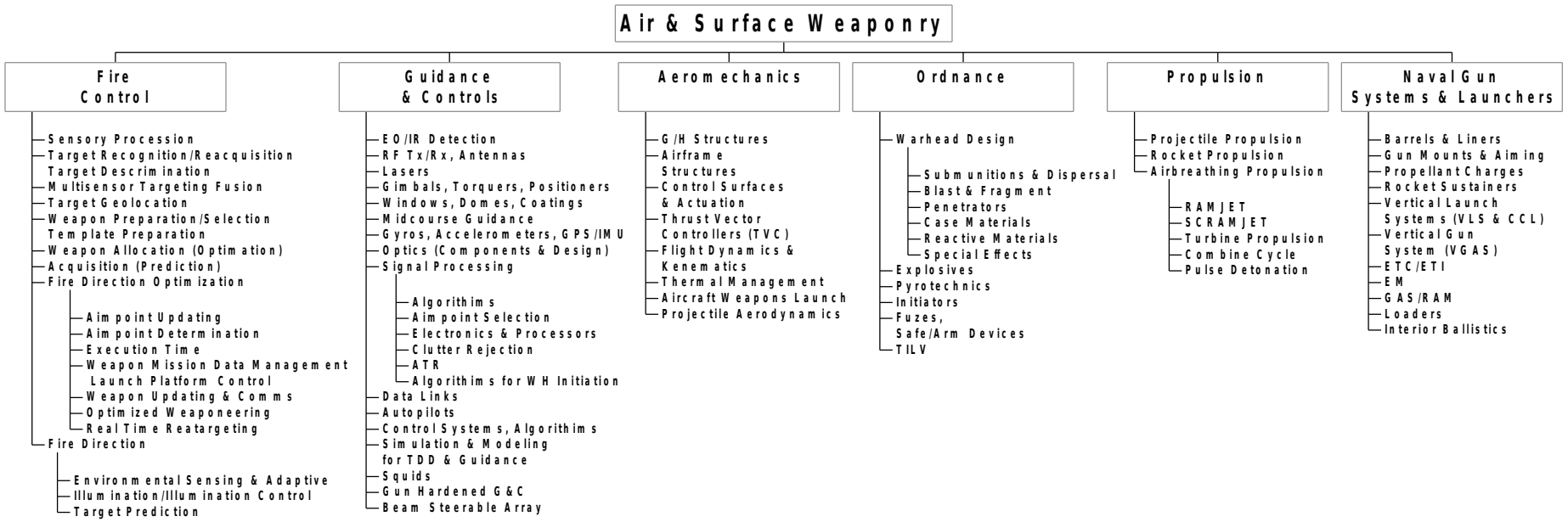


NASA Developed Technology Assessment Scale


System Test, Launch and Operations
System/Subsystem Development
Technology Demonstration*
Technology Development
Research to Prove Feasibility
Basic Technology Research
9. Actual system "flight proven" through successful mission operations
8. Actual system completed and "flight qualified" through test and demonstration (ground/flight)
7. System prototype demonstration in a flight/space environment
6. System/subsystem model or prototype demonstration in a relevant environment
5. Component and/or breadboard validation in relevant environment
4. Component and/or breadboard validation in laboratory environment
3. Analytical and experimental critical function and/or characteristic proof of concept
2. Technology concept and/or application formulated
1. Basic principles observed and reported
ASWT PROGRAM FOCUS

** Note: TRL=6 is a threshold level start of DDT and E program*

ASWT TAXONOMY



NAVAL AIR SUPERIORITY TECHNOLOGY GOALS

AAW Goals	**Baseline 1995**	**2005**	**2010**	**2015**
MISSILE KINEMATICS			(AIM - 120C ref)	(AIM - 120C ref)
Flyout Range	AIM - 9X, AIM-120C	**+ 25 %**	**+ 100 %**	**+ 130 %**
Average Velocity		**+ 10 %**	**+ 20 %**	**+ 30 %**
Maneuverability		**+ 45%**	**+ 65%**	**+ 85%**
Wpn Launch Angle		**+ 20 %**	**+ 40 %**	**+ 60 %**
SEEKER PERFORMANCE				
Acquisition Range	(IR lookdown)	**+ 100 %**	**+ 250 %**	**+ 300 %**
Off Boresight Angle		**135° / 180°**	**–**	**–**
90% Tgt Acquisition in CM	Pyrotechnic Flare	**Pyrophoric Flare**	**Laser on Fast A/C**	**Explosively Generated CM**
ORDNANCE LETHALITY				
Warhead Control Accuracy	(Edge Detect)	**Centroid**	**Target State**	**Defined Aimpoint**
Payload Size	AIM- 120C	**- 20%**	**- 30%**	**- 50%**
COOPERATIVE FIRE CONTROL	(≥ lethality)	t.b.d	t.b.d	t.b.d
AFFORDABILITY		**Guidance Integrated Fuzing**	**Common Processing**	**Multirole Missile**

AIR SUPERIORITY WARFIGHTER PAYOFFS

- Baselines
  - **AIM-9X, AIM-120**
- Future Technology Payoffs
  - Increase Target Sets Addressed
  - Improve Exchange Ratios
    - No Escape Zone
    - Launch Acceptability Region
    - Maneuverability
    - F-Pole, A-Pole
    - Off Axis Targeting / Engagement
    - Lethality
  - Reduce Fratricide
  - Improve Weapon Separation

NAVAL FIRE SUPPORT TECHNOLOGY GOALS

	Naval Fire Support Goals		Baseline 1995	2005	2010	2015
Weapon Responsiveness	Weapon Coverage	*Gun*	13 nmi.	100 nmi.		150 nmi.
		Missile	200 nmi. 70 nmi.	150 nmi.		250 nmi. 350 nm
	Weapon Response Time	*Gun*	90 sec	2 Min. to 41 nmi		2 Min. to 63 nmi.
		Missile	2 Min. to 125nmi. 10 min. 2 min.	5 min.		2 min.
Rapid/Accurate Targeting	Sensor to Weapon + Fire Control Time		N/A	2 min	1.0 min	30 sec
	Target Location Error (TLE)		50m	10m	1m	1m (Moving Target)
	Target Acquisition		Human Observation Human Image Exploitation	Benign Pd=0.9, FA=0.1/km2 Pdecoy reject=0.9	Man-in-Loop Pd=0.9, FA=0.1/km2 Pdecoy reject=0.9	Fully Automated Pd=0.9, FA=0.1/km2 Pdecoy reject=0.9
Improved Lethality	Warhead Coupled Energy (Kj/Kg) Detonation Pressure		1.6 Mj/Kg 375 Kbar	+ 15 %	+ 30%	+ 45 %
	Lethality (Rounds per Target Effect)		250 (Suppression)	1.8 Mobility (Neutralization)	1.2 - Stationary (Destruction)	1.2 - Moving (Destruction)
	Warhead Characteristics		Fragmentation Submunitions	Dual Functions • Submunitions • Unity	Terminally Guided Warheads & Submunitions	Multifunction Reactive High Energy
Cost Effective Sustainability	Reliability/Sustainability (Artillery Battery/Loadout)		(Gun Only) <5 Suppression Missions	(Gun Only) 1 for X Days	(Gun & Missile) 1 for Y Days	(Gun & Multi-Whd Missile) 1 for Z Days
	Cost Effectiveness (Relative Cost per Kill)		1.00 Soft,Stationary Target At 10 nmi.	0.30	0.08	0.04

Naval Surface Fire Support
WARFIGHTER PAYOFFS

- Baselines
  - **5”/54 MK45, RGM-66 SSSM**
  - **Advanced/Engineering Development: 5”/62, NTACMS, LASM**
- Future Technology Payoffs
  - Increase Effective Range
  - Improve Kills/magazine
  - Robust Targeting
  - Decrease System Response Time
  - Decrease Cost/Kill
  - Increase Target Sets Addressed
  - Enhance Sustainability
  - Increase Availability
    - Weather
    - ECM

SHIP BASED DEFENSE TECHNOLOGY GOALS

Ship Defense Goals	Baseline 1995	2005	2010	2015
Raid Survivability				
Engagements per Stressing Threat	1-2	2-3	6-7	6-7
Simultaneous/Total Targets Engaged		2-4/4	4/8	4/8
Catastrophic Kill Probability Given Intercept	0.1-0.8	0.6-0.8	0.6-0.8	0.8-0.95
Maneuver Counter Capability		20 G's	30 G's	50 G's
Command Decision Margin		15 sec	15 sec	15 sec (Adverse Environment)
Adverse Environment				
Robust Weapon Control and Intercept (Threat)	Sea Skimming Subsonic Supersonic	Sea Skimming Supersonic Maneuvering	Low Signature Supersonic Maneuvering	Advanced & Technologically Feasible Sea/Land Based
Robust Weapon Control and Intercept (Countermeasures Defeat)	Broadband Jamming & Flares	Broadband, Coherent & Terrain Bounce Jamming	Submissiles & Associated Decoys	Submissiles, & Associated Decoys
Robust Weapon Control and Intercept (Environment)		Adverse Propagation, Rain, Fog, Multipath Near Land Clutter	Adverse Propagation Dense Littoral Environment Near Land Clutter	Adverse Propagation Dense Littoral Environment Near Land Clutter

SHIP BASED DEFENSE*
WARFIGHTER PAYOFFS

- Baselines: CIWS (Terminal), RAM (Nearby/Short Range)/P3I, NSSM/ESSM (Local/Intermediate Range), Surface Launched Harpoon (Close in), 5”/54 (Std Surface-Surface)
- Raid Survival versus Advanced Threats
  - Signature
  - Altitude
  - Maneuver
  - Speed
- Universally/All Ships Compatible
  - Support PEO desire to Neckdown
- Affordable
  - Development
  - Production
  - Life Cycle

- Robust System Performance
  - –Countermeasures
  - –Weather
  - –Availability
  - –Short Reaction
  - –Situational Awareness

* SM-2 and CE counted as Area/Theatre Defense Weapons

STRIKE TECHNOLOGY GOALS

STRIKE Goals	Baseline 1995	2005	2010	2015
ACCURATE, RESPONSIVE TARGETING	*(SOAD, SOPD)*			
Accuracy (TLE)	30-50 m	**5 m**	**1 m**	**-**
Target/Weapon Pairing Rate	2/hr	**20/hr**	**100/hr**	**Real time On board**
REALTIME RETARGETING	*(SOTD)*			
Rapid Planning & Optimization	(Manual >hours)	**<5 min**	**<1 min**	**-**
Weapon Based ATR	(>90% Acq Fixed Target)	**>90% Acq Lim Clutter**	**>90% Mod Clutter**	**>60% Hvy Clutter**
SENSOR PERFORMANCE				
GPS Jamming Immunity	Antijam (S/J)	**+20 dB**	**+30 dB**	**-**
Clutter Immunity	Low (LGB)	**Natural**	**Structured w/minor occlusion**	**All Clutter w/moderate occlusion**
Adverse Weather	Vis Flt Rules	Light Rain, Fog, Haze	Medium Rain, Fog, Clouds	Heavy Rain, Fog, Clouds
LETHALITY *w/min collateral damage*	3 Wpns/Aimpt fixed	1.25/Aimpt fixed	1 Wpn/Site multiple tgts	1 Wpn/mobile disbursed tgts
RESPONSIVE WEAPONS				
Ave Velocity	M<1	**M=4**	**M=6**	**M=8**
Wpn Flyout Range	(A/L SOAD)	**+50%**	**-**	**+200 %**
Hard Target Penetration	(J DAM/BLU-109, SLAM-ER)	**5X**	**7X**	
AFFORDABILITY	**COTS/GOTS**	**Common Processing**	**Common Sensors**	**Multirole Weapon**

STRIKE MISSION WARFIGHTER PAYOFF

- Baselines
  - **A/C Guns & Rockets, GP Bombs, JDAM, JSOW, JSOW Unitary, SLAM/SLAM ER, HARM Blk V, Tomahawk Blk IV**
  - **Launchers: F-18, JSF, Ships & Subs**
- Future Technology Payoffs
  - Enlarge Engagement Envelope (Time of Arrival, Range)
  - Decrease Response Time (Time to Target, MP Timeline)
  - Increase Survivability
  - Increase Lethality (Payload, Weapons/Kill, Accuracy)
  - Increase Target Sets Addressed (Time Critical, Relocatable, Hard, Area, Mobile)
  - Affordability
  - Mission Flexibility (Retargeting)
  - Firepower (Loadout, Kills/Pass)

SUMMARY

– Navy has instituted a structured, disciplined technology planning/execution process that provides a national focus

– Strong linkage to Strategy-to-technology process

– Process provides for strong Government/Industry/Academia participation and Investment

– Navy ASWT Program modeled after highly successful IHPTET/IHPRPT Programs

– Provides a rationale/framework for Navy S&T and Industry IR&D investments in areas of Naval ASWT

A consistent, stable funding line guarantees a consistent, stable flow of Navy Air & Surface Weapon Technology Options

Navy ASWT
Ongoing Programs

HYPERSONIC SPEED WEAPON SYSTEM (M > 6)

TOPART - UAV BASED HIGHLY ACCURATE TARGETING SYSTEM

CRUISE MISSILE REAL TIME RETARGETING (CMRTR)

UN-INHABITED COMBAT AIR VEHICLES (UCAVS)

IHPRPT - INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY (DOD/INDUSTRY WIDE PROGRAM)

ADVANCED ANTI- RADIATION GUIDANCE DEMONSTRATION (AAGD)

SURGICAL STRIKE ADAPTABLE VIDEO AND DATA COMMUNICATIONS SYSTEM

CONCENTRIC CANISTER LAUNCHER (CCL)

PRECISION STRIKE NAVIGATOR (PSN)

BALL JOINT GIMBAL

NAVAL FIRE CONTROL SYSTEM (NFCS)

GUIDANCE INTEGRATED FUZING (GIF)

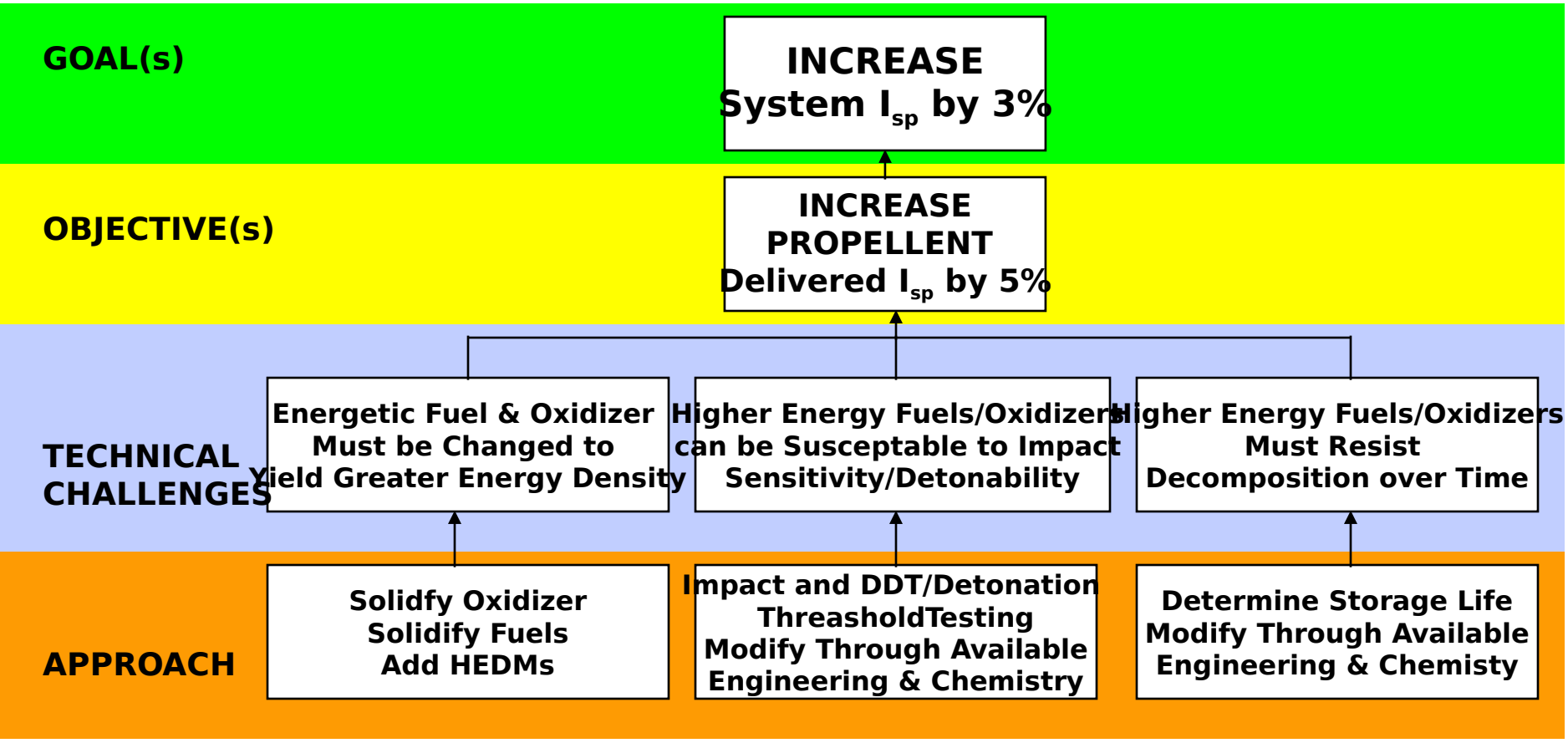
SHIP BASED LASER MISSILE DEFENSE SYSTEMS

Illustrative Example: Typical "GOTCHA"

Goal - Objectives - Technical Challenges - Approaches

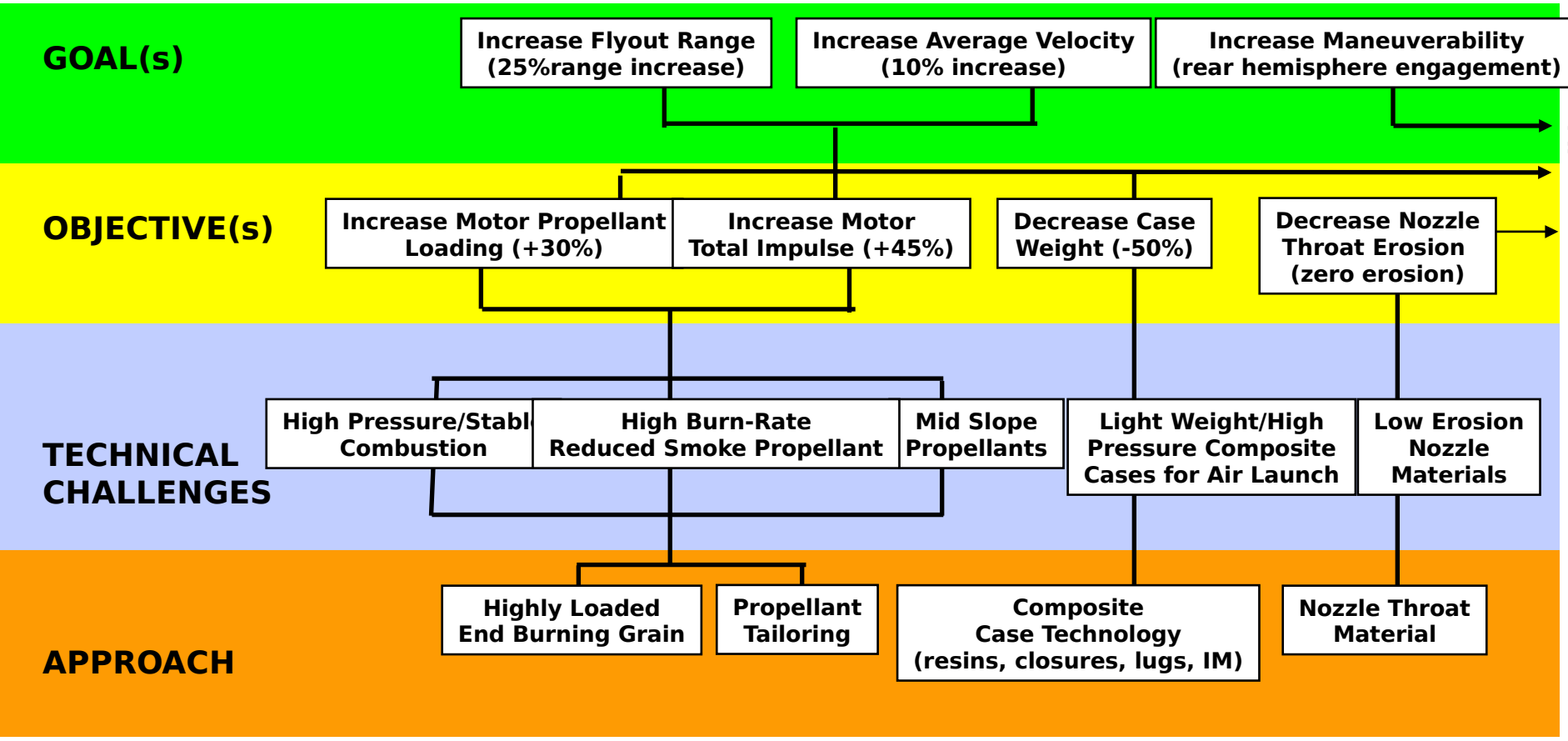
Chart

(From IHPRTPT Program Documentation)


GOAL(s)
INCREASE System I_{sp} by 3%
OBJECTIVE(s)
INCREASE PROPELLENT Delivered I_{sp} by 5%
TECHNICAL CHALLENGES
Energetic Fuel & Oxidizer Must be Changed to Yield Greater Energy Density
Higher Energy Fuels/Oxidizers can be Susceptable to Impact Sensitivity/Detonability
Higher Energy Fuels/Oxidizers Must Resist Decomposition over Time
APPROACH
Solidfy Oxidizer Solidify Fuels Add HEDMs
Impact and DDT/Detonation ThreasholdTesting Modify Through Available Engineering & Chemistry
Determine Storage Life Modify Through Available Engineering & Chemisty

Illustrative Example: ASWT Air Superiority FY05 Goals - Propulsion

FOR EXAMPLE ONLY, NOT MEANT AS GUIDANCE


GOAL(s)
Increase Flyout Range (25%range increase)
Increase Average Velocity (10% increase)
Increase Maneuverability (rear hemisphere engagement)
OBJECTIVE(s)
Increase Motor Propellant Loading (+30%)
Increase Motor Total Impulse (+45%)
Decrease Case Weight (-50%)
Decrease Nozzle Throat Erosion (zero erosion)
TECHNICAL CHALLENGES
High Pressure/Stabl Combustion
High Burn-Rate Reduced Smoke Propellant
Mid Slope Propellants
Light Weight/High Pressure Composite Cases for Air Launch
Low Erosion Nozzle Materials
APPROACH
Highly Loaded End Burning Grain
Propellant Tailoring
Composite Case Technology (resins, closures, lugs, IM)
Nozzle Throat Material

INDUSTRY PROPOSALS

PREVIOUS GOOD BAA PROPOSALS MIGHT INCLUDE...*

- **MISSION AREA SUPPORT DISCUSSION**
- **STATEMENT OF WORK - TECHNICAL BASIS, APPROACH, SUMMARY & GOTCHA CHARTS**
- **TARGETED SYSTEM / MISSION FOR TECHNOLOGY TRANSITION**
- **DETAILED ROADMAP**
  - **PROGRAM PLAN BY QUARTER AND GOVERNMENT FISCAL YEAR (OCT-SEPT)**
  - **FISCAL INFORMATION BY QUARTER AND GOVERNMENT FISCAL YEAR (OCT-SEPT)**
  - **IDENTIFIED IR&D INVESTMENTS**
  - **IDENTIFIED LEVERAGED FUNDED PROGRAMS (BY DoD PE Number)**
  - **PRODUCTS / DELIVERABLES SCHEDULE**
- **PROPRIETARY CLAIMS**
- **MANAGEMENT APPROACH**
  - **TEAMING, SUBCONTRACTORS or PARTNERS**
  - **ORGANIZATIONAL CHART**
- **VENDOR DESCRIPTION**
  - **COMPANY SIZE, LOCATION, SPECIALIZED EQUIPMENT**
  - **EXISTING RESEARCH & DEVELOPMENT EFFORTS**

NAVY ASWT - INDUSTRY DAY CONFERENCE (TBD)